

70035
Basalt
5765 grams

DRAFT

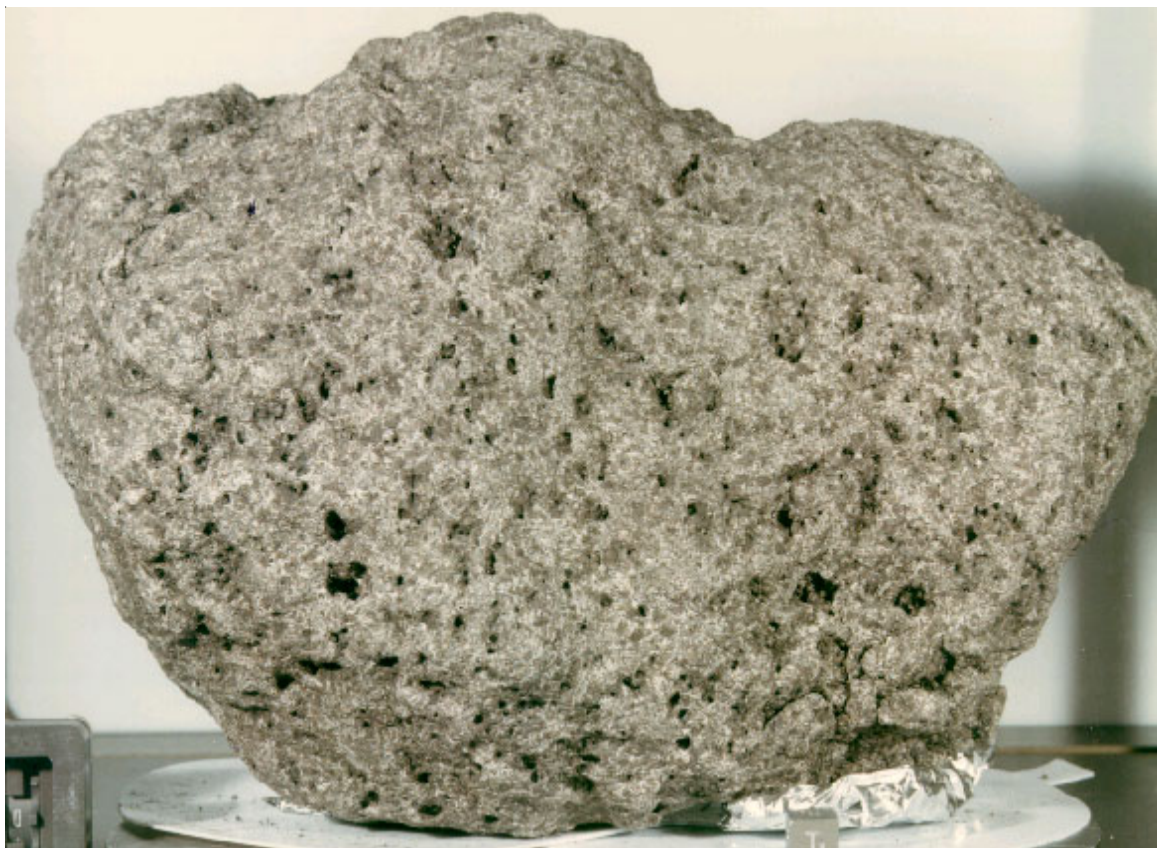


Figure 1. Photograph of top surface of 70035 illustrating vugs and vesicles. Cube is 1 cm. NASA photo # S72-56385.

Introduction

Sample 70035 is another vesicular, medium-grained, high-Ti basalt similar to 70017 (figure 1). It was collected from a boulder on the rim of a subdued crater about 45 meters east northeast of the LM. This large sample was not oriented, and has been used for several public displays (figure 11).

The bottom surface of this sample is coated with glass (figure 10). The other surface have micrometeorite pits.

Petrography

Ridley (1973), Weigand (1973) describe this large basalt. It is a hypidiomorphic granular basalt with large anhedral clinopyroxene enclosing armalcolite, ilmenite,

Mineralogical Mode of 70035

	Brown et al. 1975	Weigand 1973	Roedder and Weiblen 1975
Olivine	0.9 vol. %	2.5	
Pyroxene	47.5	46	56.6
Plagioclase	25.9	26	21.6
Opakes	23.7	22	15.4
Silica	1.6		1.6
Mesostasis	0.4	2	4.4
Vesicles		1.5	

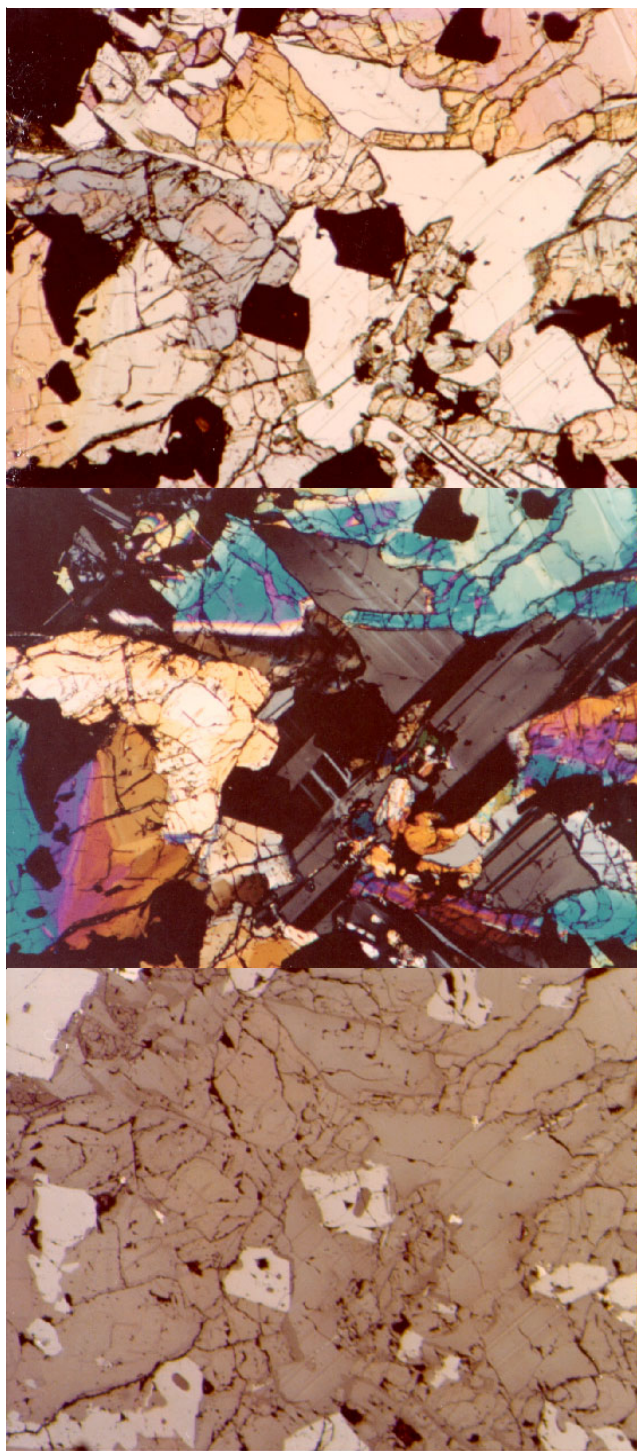


Figure 2: Photomicrographs of thin section 70035,14. Each view of same area, 2.7 mm wide. a) Partially polarized light, b) crossed-polarized light, c) reflected light.

ulvöspinel and chrome spinel. Interstitial plagioclase encloses ilmenite and olivine. The mesostasis includes cristobalite, K-feldspar, tranquillityite, ilmenite, ulvöspinel, troilite and pale brown granitic glass.

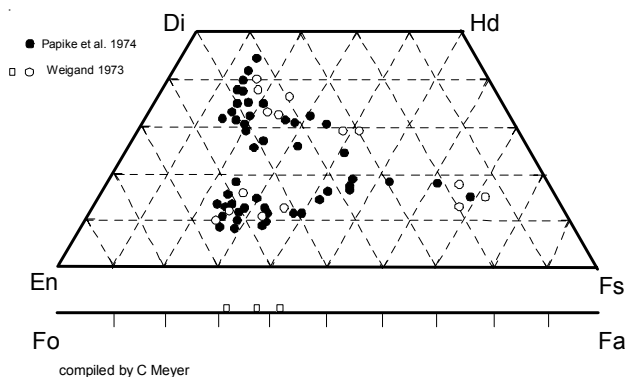


Figure 3: Pyroxene and olivine composition of 70035 (data replotted from Papike et al. 1974, Weigand 1973).

El Goresy and Ramdohr (1975) showed that subsolidus reduction of the opaques in 70035 and other Apollo 17 basalts occurred below 830 deg. C. The cooling rate was less than 1 deg. C /hr. (Usselman et al. 1975).

Mineralogy

Pyroxene: Weigand (1973) and Papike et al. (1973) give pyroxene data (figure 3). Augite cores contains up to 3.5 % TiO_2 , 4.3 % Al_2O_3 and 1% Cr_2O_3 (Weigand 1973).

Plagioclase: □ Weigand (1973), Crawford (1973), Delaney and Sutton (1991) and Delaney et al. (1992) discuss plagioclase zonation (An_{88-83}).

Opaques: El Goresy and Ramdohr (1975) studied the subsolidus reduction of ilmenite to rutile, spinel and metallic iron in 70035. They also found that the ulvöspinel reduced to form exsolution of ilmenite and metallic iron.

Glass: Ilmenite in 70035 contains glass inclusions of two types, a) 6-7% K_2O and b) 0.4% K_2O (Roedder and Weiblen 1975).

Chemistry

The chemical composition of 70035 is given in table 1 and figure 4 and 5.

Radiogenic age dating

Stettler et al. (1973), Evensen et al. (1973a, b) and Nyquist et al. (1974) have dated 70035 (see figures 6-8 and summary table). The ages of basalts from Apollo 17 are similar to those of Apollo 11.

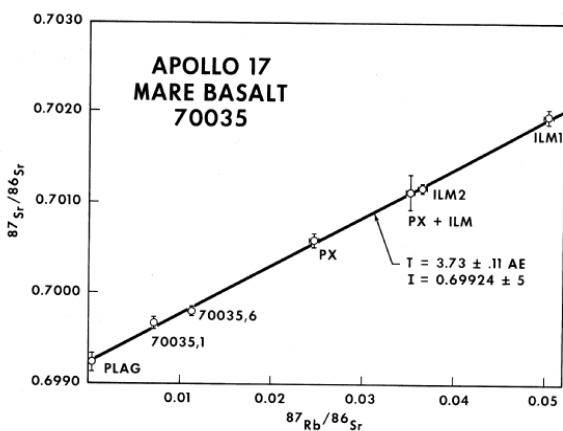


Figure 4: Rb-Sr isochron for 70035 (from Nyquist et al. 1974).

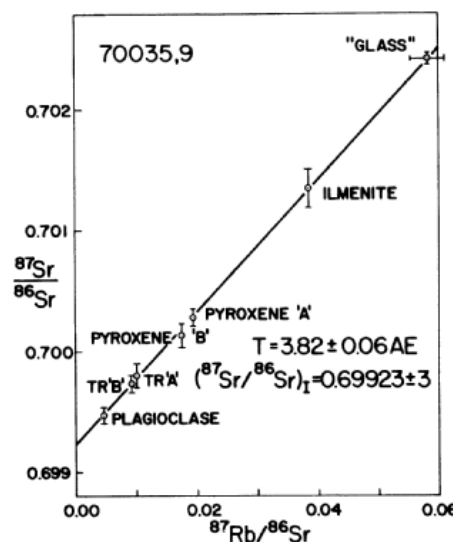


Figure 6: Rb-Sr isochron diagram for 70035 (from Evensen et al. 1973).

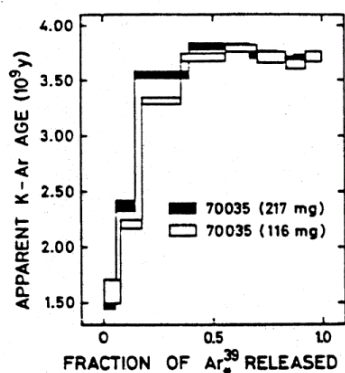


Figure 5: Ar-Ar release diagram for 70035 (from Stettler et al. 1974).

Cosmogenic isotopes and exposure ages

Stettler et al. (1973) determined an exposure age of 95-100 m.y. by the ^{38}Ar method. Drozd et al. (1977) determined 122 ± 3 m.y. by ^{81}Kr method.

Other Studies

Pearce et al. (1974) determined the magnetic properties and found that Apollo 17 basalts contained more metallic iron than most other basalts (consistent with petrology).

Processing

This rock is discussed in great detail in the Apollo 17 catalog by Neal and Taylor (1993). It has been sawn a number of times (figures 9-10).

Summary of Age Data for 70035

	Rb-Sr	Ar-Ar
Evensen et al. 1973a,b	3.82 ± 0.06	
Stettler et al. 1973		3.75 ± 0.07
Nyquist et al. 1974	3.73 ± 0.11	

Table 1. Chemical composition of 70035.

reference	LSPET 73		Shih 75	
weight		,1	,6	
SiO ₂ %	37.8	(a)		
TiO ₂	13	(a)		
Al ₂ O ₃	8.85	(a)		
FeO	18.5	(a)		
MnO	0.28	(a)		
MgO	9.89	(a)		
CaO	10.1	(a)		
Na ₂ O	0.35	(a)	0.27	0.23
K ₂ O	0.06	(a)	0.04	0.05 (b)
P ₂ O ₅	0.05	(a)		
S %	0.15	(a)		
sum				
Sc ppm			82.5	(c)
V				
Cr	4174	(a)	3890	3634 (b)
Co				20.7 (c)
Ni	2	(a)		
Cu				
Zn	4	(a)		
Ga				
Ge ppb				
As				
Se				
Rb	0.7	(a)	0.461	0.628 (b)
Sr	176	(a)	174	161 (b)
Y	75	(a)		
Zr	205	(a)	217	200 (b)
Nb	20	(a)		
Mo				
Ru				
Rh				
Pd ppb				
Ag ppb				
Cd ppb				
In ppb				
Sn ppb				
Sb ppb				
Te ppb				
Cs ppm				
Ba		62.1	79.5	(b)
La		4.79	7.04	(b)
Ce		16.4	23.4	(b)
Pr				
Nd		18.2	25.9	(b)
Sm		7.63	10.5	(b)
Eu		1.82	1.88	(b)
Gd		11	13.5	(b)
Tb				
Dy		14.1	18.8	(b)
Ho				
Er		8.4	11	(b)
Tm				
Yb		7.79	10	(b)
Lu				
Hf				
Ta				
W ppb				
Re ppb				
Os ppb				
Ir ppb				
Pt ppb				
Au ppb				
Th ppm				
U ppm		0.091	0.12	(b)
technique	(a) OES, (b) IDMS, (c) INAA			

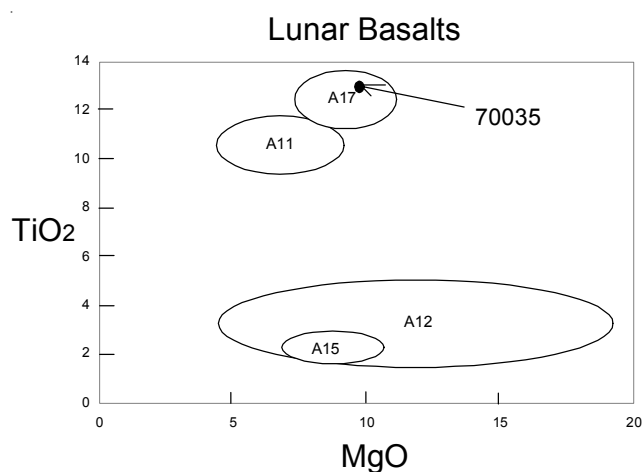


Figure 7: 70035 is a typical high Ti Apollo 17 basalt.

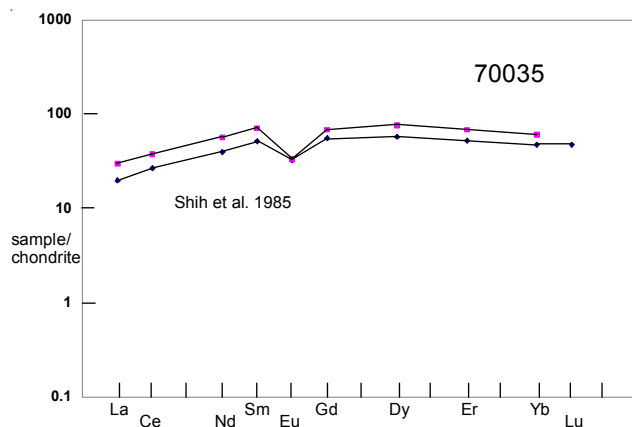


Figure 8: Normalized rare-earth-element diagram for 70035 (data from Shih et al. 1975).



Figure 9: First saw cuts of 70035 made in 1972.



Figure 10: Additional saw cuts of 70035 made in 1981 (see flow diagram).

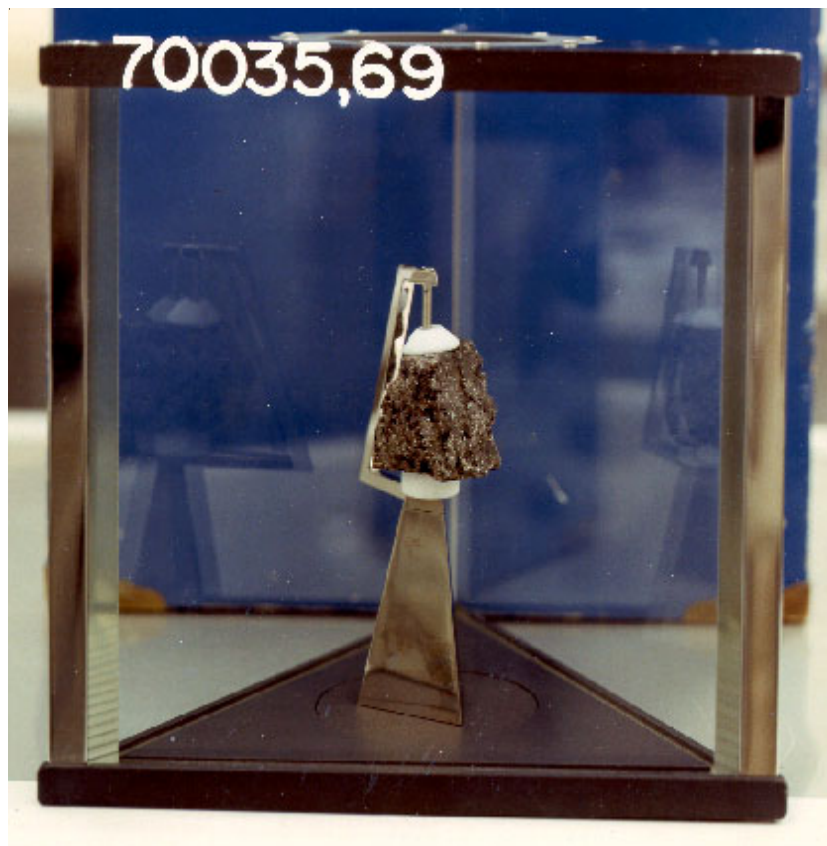
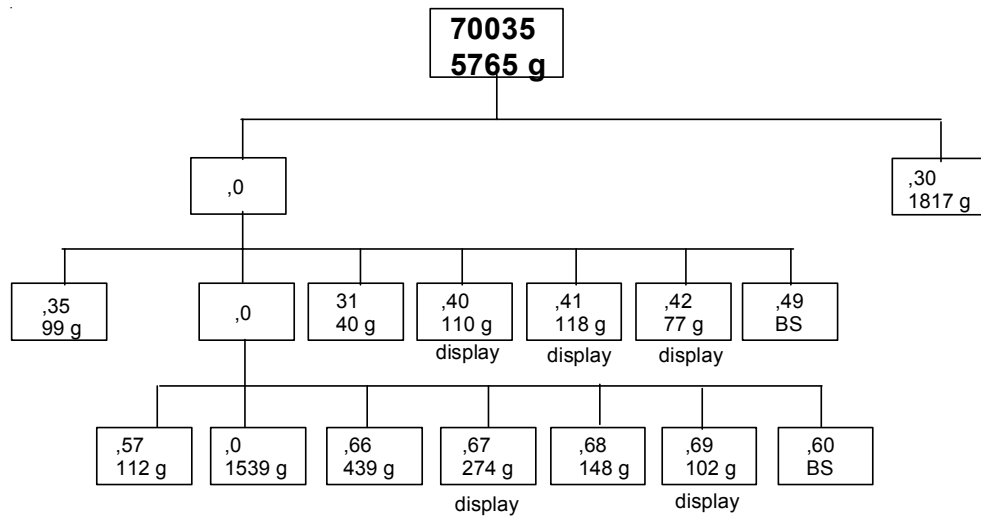


Figure 11: A piece of 70035 in its dry nitrogen display case.